

Deep Learning: A Comprehensive Overview on Techniques, Taxonomy, Applications and Research Directions

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Abstract

Deep learning (DL), a branch of machine learning (ML) and artificial intelligence (AI) is nowadays considered as a core technology of today's Fourth Industrial Revolution (4IR or Industry 4.0). Due to its learning capabilities from data, DL technology originated from artificial neural network (ANN), has become a hot topic in the context of computing, and is widely applied in various application areas like healthcare, visual recognition, text analytics, cybersecurity, and many more. However, building an appropriate DL model is a challenging task, due to the dynamic nature and variations in real-world problems and data. Moreover, the lack of core understanding turns DL methods into black-box machines that hamper development at the standard level. This article presents a structured and comprehensive view on DL techniques including a taxonomy considering various types of real-world tasks like supervised or unsupervised. In our taxonomy, we take into account deep networks for supervised or discriminative learning, unsupervised or generative learning as well as hybrid learning and relevant others. We also summarize real-world application areas where deep learning techniques can be used. Finally, we point out ten potential aspects for future generation DL modeling with research directions. Overall, this article aims to draw a big picture on DL modeling that can be used as a reference guide for both academia and industry professionals.